An evaluation of the coverage of theoretically based implementation factors in disseminated classroom physical activity programs

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Abstract

Classroom-based physical activity (CBPA) is increasingly recommended as a method to support children's physical activity, health, and academic performance. Many adoption-ready programs exist to aid in the implementation of CBPA in schools; yet, implementation rates remain low. The purpose of this study was to evaluate the extent to which resources provided by adoption-ready CBPA programs addressed theory-based implementation contextual factors to support implementation. Existing CBPA programs (N = 37) were identified through Internet searches and all materials (e.g., implementation guides) provided by each program were coded for their inclusion of 51 implementation factors based on the Consolidated Framework for Implementation Research (CFIR). Analyses were conducted to compare inclusion of implementation factors across CFIR Domains and by three program groupings: free (yes/no), research evidence (yes/no), and targeted to teacher only (vs. school). Programs covered a mean of 25.9 per cent (SD = 18.7 per cent) of the 14 Inner Setting implementation factors, 34.2 per cent (SD = 18.0 per cent) of the 6 Characteristics of Individuals implementation factors, and 34.8 per cent (SD = 24.3 per cent) of the 8 Process implementation factors. Programs with research evidence covered more implementation factors than programs without research evidence (43.7 vs. 25.9 per cent; p < .05). Although numerous adoption-ready CBPA programs are available and have many strengths, their inclusion of theory-based factors that support or inhibit implementation is generally low. Consideration of such factors, including organizational climate and teacher-level behavior change, is likely critical to supporting ongoing school-wide implementation of CBPA. Research is needed to develop and test effective strategies for addressing these factors to support more widespread CBPA implementation.

Key words

Consolidated Framework for Implementation Research, Teacher, Dissemination, School, Behavior change

BACKGROUND

Reimagining ways to promote and provide physical activity (PA) opportunities to children and youth is especially important now, considering the prevalence of childhood obesity in the USA [1]. Given the volume of time children spend at school, efforts to provide PA opportunities in school settings are increasingly common. Schools are encouraged to establish a Comprehensive School Physical Activity Program, with PA opportunities before, during, and after school. Along with quality physical education [2] and daily recess, offering classroom-based physical activity (CBPA) is an integral part of a Comprehensive School Physical Activity Program that optimizes PA during school hours [3–5]. Multiple studies have shown that CBPA can be effective for increasing children's PA [6–12]. Interest in school-based PA and CBPA has grown rapidly over the last two decades [13], in part due to PA's ability to improve student learning outcomes [14,15] and on-task behavior [7,10,16].

Many entities, including nonprofit organizations (e.g., American Heart Association, Let's Move Active Schools); businesses (e.g., Recess Rocks, Go Noodle); individuals; and organizations such as universities, state departments of education, and local educational agencies, have developed packaged,

Implications

Practice: Numerous programs and resources are available for school staff who wish to increase classroom activity practices at their school, and end users should select programs/resources that fit their needs while considering the importance of school-wide implementation factors.

Policy: To maximize policy effectiveness for supporting school-wide implementation, policy language could be adopted from implementation guides included in existing classroom physical activity programs.

Research: Researchers should develop and test implementation strategies for supporting ongoing school-wide classroom physical activity, including as a component within a comprehensive school physical activity approach.

adoption-ready programs that include structured materials to aid in CBPA delivery. Despite the wide availability of such programs, national data suggest that less than 50 per cent of teachers offer CBPA opportunities to their students [17], and intervention studies have shown low rates of implementation after school- or district-level adoption, with even lower maintenance at long-term follow-up [7,18,19]. Both classroom-level contextual factors, such as resource availability and teacher attitudes and perceived confidence, and school-level contextual factors, such as school climate, district and school-level leadership engagement, and process monitoring, influence implementation and maintenance of CBPA [20–27]. It is posited that CBPA programs will have higher rates of implementation and maintenance when theory-based implementation contextual factors [28] are addressed.

To date, the breadth and depth of implementation support provided for schools, teachers, and other school stakeholders by CBPA programs has not been systematically studied. A logical next step toward supporting successful CBPA implementation is to identify the extent to which existing adoption-ready programs address multilevel implementation supports.

Purpose

The primary purpose of this study was to use the Consolidated Framework for Implementation Research (CFIR) [28] to investigate the inclusion of factors related to school- and classroom-level implementation among existing free and fee-based CBPA programs. A secondary aim examined program inclusion of implementation factors across Intervention Characteristics of interest, including program cost, availability of research evidence, and target audience (teacher vs. school). This research focused on adoption-ready programs accessible to school stakeholders for use in real-world contexts.

METHODS

Identification of programs

A systematic search was conducted in mid-2017 in PubMed, Google Scholar, and Google, to review both scientific and grey literature and identify adoption-ready programs directed at supporting delivery of CBPA. Search terms included classroom physical activity + programs + interventions; active classroom; activity breaks; active lessons; classroom breaks + exercise; and classroom physical activity. Programs typically had their own website, were available for purchase on a marketplace website (e.g., Amazon), or were hosted on another website such as a state health department or department of education website. Included programs were as follows: (a) published in English language; (b) at least partially aimed to increase PA in the classroom

(could also address other sources of PA during school); and (c) targeted any grade K-6th. Programs were excluded if they: (a) did not address classroom physical activity; (b) were created as part of a research study but were not available to the public, even upon request; (c) were once available, but no longer had active websites (i.e., materials were no longer accessible due to broken links); and (4) were from a country other than the USA. All materials for each program, including PDFs, PowerPoints, manuals/guides, handouts, and posters, were downloaded or purchased. We contacted programs that offered training but did not include training materials on their website to request these materials. Two contacts stated that they did not have training materials because the training was more informal. Two provided a training PowerPoint, but the PowerPoint did not include information that was not already included in other materials.

List of implementation factors and definitions

CFIR was selected to guide this work due to its wide coverage of multiple levels (i.e., individual and organizational) of implementation contextual factors [28,29], evidence of explaining variation in implementation in previous work [30], relevance to setting/organizational-based interventions such as school PA, and familiarity among the investigators. The CFIR includes 36 constructs that reflect barriers and facilitators to implementation, grouped under five domains: Intervention Characteristics (key attributes of interventions), Outer Setting (factors outside the organization), Inner Setting (factors within the organization), Characteristics of Individuals (perceptions, attitudes, and motivation of individuals), and Process (strategies to support implementation) [31].

For the present study, 22 CFIR constructs were selected for inclusion and one or more CBPA-specific implementation factors were mapped to each CFIR construct. The identification of constructs drew on the authors' experience and knowledge of the literature and was conducted using an iterative approach that involved four meetings among the authors. The primary investigator and a research assistant first drafted the initial list of CBPA-specific implementation factors and definitions, mapped to CFIR. The list was then discussed with the other study team members over the four meetings, and refinements were made until consensus was reached. This resulted in a list of 51 CBPA-specific implementation factors, which is presented in Appendix A. There were 23 CBPA-specific implementation factors for the Intervention Characteristics domain of CFIR, 14 for the Inner Setting, 6 for the Characteristics of Individuals, and 8 for Process. We also categorized each CBPA-specific implementation factor as being related to the school-teacher relationship (i.e., teacher and systems change; $N = 7$ implementation

factors) or the teacher–student relationship (i.e., student behavior change; N = 21 implementation factors), which we refer to as the "school/teacher grouping" (see Table 1 for factor groupings). Implementation factors within the Intervention Characteristics domain were not categorized using the school/teacher grouping because they were not specific to one grouping.

Coding procedures

A coding guide was created that included the CBPA-specific implementation factor names and definitions, the related CFIR construct name and short description (which are broader and not CBPA-specific), and coder instructions. Coders then reviewed all materials for each program, including downloaded materials and website content. Coders excluded program content related to a topic other than CBPA (e.g., if the construct was included but in relation to recess, it did not count). As part of an initial coder training process, all coders independently coded the same three programs and subsequently reconciled codes.

The 23 CBPA-specific implementation factors within the Intervention Characteristics CFIR Domain were coded as 0 = not present versus 1 = present. A single coder compiled this information, since the implementation factors were easily identifiable and required little-to-no judgment or interpretation from the coder. The other 28 CBPA-specific implementation factors were coded as 0 = not included in the program, 1 = included in the program but at a minimal level, and 2 = included more than minimally in the program. For these implementation factors, each program was independently coded by two of the five coders, and discrepancies were reconciled through discussion. For the present analyses, codes were dichotomized as 0 or 1, with the 1s and 2s combined, since few implementation factors received a score of 2. The 2s were then used to qualitatively highlight best examples. Index scores for each CFIR Domain (except Intervention Characteristics) and for implementation factors addressing the school/teacher relationship were created by taking a sum of the scores across factors divided by the total number of factors within the domain/grouping.

After code reconciliation was completed, research staff reached out to program contacts via email with the results of the coding for their program, and gave them the opportunity to raise questions about potential errors. Only one program noted an error in coding, which was related to an implementation factor within the Intervention Characteristics domain. The results presented reflect the revision to this code.

Statistical analyses

The number and percent of programs receiving a score of 1 for each implementation factor was reported using frequency statistics. These descriptive statistics were calculated for all programs together and then calculated only for programs that were viewed as more comprehensive because they included an implementation manual, guide, or other material/resource beyond simple activity demonstrations/instructions. Inter-rater agreement was calculated for each of the 28 double-coded implementation factors using percent agreement, and for index scores using intraclass correlations (ICCs). Percent agreement was evaluated with the criteria of ≥ 75 per cent as good to excellent, 60%–74% as moderate, and <60 per cent as poor [32]. ICC magnitude was classified using criteria of poor (≤0.40), fair (0.41–0.60), good (0.61–0.80), and excellent (0.81–1.0) [31]. Logistic regression was used to investigate differences in the inclusion of each of the 28 double-coded implementation factors (dependent variable) by three Intervention Characteristics that were considered key factors related to program selection (independent variables, entered in separate models): (i) free (yes/no), (ii) research evidence (yes/no), and (iii) targeted to teacher only (vs. school) (yes/no). Chi-square statistics are presented when an odds ratio was not able to be calculated due to no inclusion of the implementation factor in one of the groupings (e.g., free vs. cost). Index scores were summarized using means and standard deviations. Differences in the index scores (dependent variables) by the aforementioned three key Intervention Characteristics (independent variables) were investigated using t tests.

RESULTS

Of the 42 programs initially identified, four were excluded because they were not from the USA and one was excluded because it was deemed to be an opinion blog rather than a packaged program. A list of the 37 included programs is provided in Appendix B. Across all programs, 20 of the 28 dichotomous implementation factors had good-to-excellent percent agreement (75.7%–97.3%) between coders, and the other 8 had moderate percent agreement (64.9%–73%). ICCs for the index scores demonstrated fair agreement for Inner Setting (ICC = .592), good agreement for Characteristics of Individuals (ICC = .614), Process (ICC = .765), school-teacher relationship (ICC = .638), and excellent agreement for teacher–student relationship (ICC = .877).

Inclusion of implementation factors across programs

The least commonly included Intervention Characteristics implementation factor was *train the trainer* (individuals receive training on how to train others; 5.4 per cent), whereas the most commonly included was *original activities* (original activity ideas or instructions; 94.6 per cent; Table 2). Of the 15 programs that involved a fee, four (26.7 per cent) had research evidence. Most program fees were one time

Table 1 | Inclusion of implementation factors related to the CFIR Inner Setting, Characteristics of Individuals, and Process Domains

CFIR Domain and CBPA-specific Implementation Factor	Brief description	No. (%) of all programs that included factor N = 37 programs	No. (%) of programs with Implementation Materials that included factor[c] N = 28 programs
Inner Setting (14 factors)			
Communication[a]	Creating a network or changing the communication structure	7 (18.9%)	6 (21.4%)
Policy Incorporation[a]	Incorporating the program into policy, or reference school/district policy	9 (24.3%)	9 (32.1%)
Marketing Materials Teachers[a]	Post school-level adoption marketing focusing on teacher-level implementation	14 (37.8%)	14 (50.0%)
Marketing Materials Students/ Parents[b]	Post school-level adoption marketing targeting students and/or parents	10 (27.0%)	9 (32.1%)
Gauging/Affecting Climate[a]	Gauging or affecting the school climate regarding classroom PA	6 (16.2%)	6 (21.4%)
Leadership Initial Buy In[a]	Increasing administrator buy-in for program adoption	9 (24.3%)	9 (32.1%)
Student Management[b]	Managing student behavior in the classroom during PA	15 (40.5%)	13 (46.4%)
Compatibility Adaptations[b]	Adapting activities based on early implementation and compatibility	21 (56.8%)	19 (67.9%)
Incentives[a]	Providing incentives for teachers	7 (18.9%)	7 (25.0%)
Goal Setting[a]	Setting goals to support teacher implementation of classroom PA	3 (8.1%)	3 (10.7%)
Monitoring[a]	Monitoring teacher implementation of classroom PA	11 (29.7%)	11 (39.3%)
School Readiness[a]	Scaling/tailoring the program based on the school's level of readiness	2 (5.4%)	2 (7.1%)
Leadership Engagement Post Adoption[a]	Increase leadership support and/or involvement around implementation	6 (16.2%)	5 (17.9%)
Classroom Structure[b]	Restructuring the physical classroom environment or tailor activities based on classroom structure	14 (37.8%)	14 (50.0%)
Characteristics of Individuals (six factors)			
Health Benefits[a]	Health benefits of classroom PA	28 (75.7%)	25 (89.3%)
Non-Health Benefits[a]	Non-health benefits of classroom PA (e.g., academics, behavior management)	30 (81.1%)	26 (92.9%)
Teacher Motivation/Attitudes Around Program[a]	Increasing teacher motivation/attitudes to implement/support the program	5 (13.5%)	5 (17.9%)
Self-efficacy[a]	Increasing teacher confidence/self-efficacy for implementing the program	5 (13.5%)	4 (14.3%)
Teacher Stage of Change[a]	Gauging a teacher's stage of change and/or tailoring approaches on this	2 (5.4%)	2 (7.1%)
Teacher Attitude/Value toward PA[a]	Improving teacher attitudes/values about their own PA	6 (16.2%)	6 (21.4%)
Process (eight factors)			
Scheduling Materials[b]	Scheduling classroom PA	17 (45.9%)	16 (57.1%)
Dose/Dose Quantity[b]	A specific number of minutes and/or frequency of activity blocks	29 (78.4%)	26 (92.9%)
Teacher Participation[b]	Increasing teacher participation in the activities	15 (40.5%)	14 (50.0%)
Implementation Leaders[a]	Identifying/appointing champions or creating new leadership roles for implementation	7 (18.9%)	7 (25.0%)
External Involvement[a]	Involving parents or community members to support/assist in the intervention	11 (29.7%)	10 (35.7%)
External Information Sharing[a]	Networking or sharing implementation information with external organizations or individuals?	14 (37.8%)	12 (42.9%)
Accountability[a]	Enforcement or accountability	1 (2.7%)	1 (3.6%)
Outcomes[a]	Assessing desired outcomes	9 (24.3%)	9 (32.1%)

[a]Factor affects school–teacher relationship for implementation.
[b]Factor affects teacher–student relationship for implementation.
[c]Materials provided by these programs were considered more comprehensive because they included guides or other content that supported implementation rather than solely activity instructions.
CFIR Consolidated Framework for Implementation Research; *CBPA* classroom-based physical activity.

fees ranging between US$10 and US$100, though some program fees were higher, for example, US$10 per month. Across the Inner Setting, Characteristics of Individuals, and Process domains, 24 of the 28 implementation factors were included in <50 per cent of programs (Table 1). The least commonly included implementation factor from these domains was *accountability* (enforcement or accountability; 2.7

Table 2 | Inclusion of implementation factors related to the CFIR Intervention Characteristics Domain

CFIR Domain and CBPA-specific Implementation Factor	Brief description	No. of (%) programs including factor (N = 37 programs)
Intervention Characteristics		
Research Evidence	Published research on the classroom PA part of the program	9 (24.3%)
Grade Specific	Separate activities targeted at different/specific grade levels	9 (24.3%)
Original Activities	Original activity ideas or instructions	35 (94.6%)
Short Activities	Activities of 5 min or less	14 (37.8%)
Long Activities	Activities of 6–10 min	12 (32.4%)
Extra-long Activities	Activities of more than 10 min	7 (18.9%)
Flexible Activity Duration/No Duration Listed	Activity duration is flexible	22 (59.5%)
Curriculum Integration	Activities that are integrated into the academic curriculum	15 (40.5%)
Activity Video(s)	Videos to use during classroom PA	15 (40.5%)
Music	Music to use during activities	8 (21.6%)
Educational Handout(s)	Brief materials/resources detailing the program or school PA	14 (37.8%)
Educational Booklet(s)	More extensive resource guides or manuals	15 (40.5%)
Educational Powerpoint(s)	Visual slide show for training	8 (21.6%)
Visiting Training	Trainer(s) come to the school/district	6 (16.2%)
Send for Training	Teachers/staff are sent to program's facility for training	2 (5.4%)
Online Training	Teachers/staff complete online training	5 (13.5%)
Train the Trainer	Individuals receive training on how to train others	2 (5.4%)
Advanced Implementation Support	Person/consultant that provides tailored/custom support	3 (8.1%)
Targeted to School	Material that targets school-level adoption	20 (54.1%)
Implementation Material(s)	Material that facilitates implementation of program (e.g., manual, guide, detailed website content)	28 (75.7%)
Funding	Materials/resources addressing how/where to apply for funds to support implementation	4 (10.8%)
Program Fee	Fee to obtain program (excluding cost for training)	15 (40.5%)
Training Fee	Fee-based training offered	8 (21.6%)

CFIR Consolidated Framework for Implementation Research; *CBPA* classroom-based physical activity.

per cent), whereas the most commonly included was *nonhealth benefits* (nonhealth benefits of classroom PA [e.g., academics and behavior management]; 92.9 per cent). The inclusion of implementation factors was slightly higher when only considering the subset of programs that included any implementation materials (N = 28). However, 20 of the 28 implementation factors were included in <50 per cent of programs.

The index scores, representing the number of factors included, differed by CFIR domain and school/teacher grouping. Fewer Inner Setting implementation factors (index score of 3.6 out of 14; 25.9 per cent inclusion) were included across programs, when compared with implementation factors related to the Characteristics of Individuals (index score of 2.1 out of 6; 34.2 per cent inclusion) and Process (index score of 2.8 out of 8; 34.8 per cent inclusion) domains (p < .05). Fewer implementation factors related to the school-teacher relationship (index score of 5.2 out of 21; 24.7 per cent inclusion) were

included across programs, when compared with factors related to the teacher–student relationship (index score of 3.3 out of 7; 46.7 per cent inclusion; p < .05).

Implementation factor inclusion by key Intervention Characteristics

There were no significant differences in the inclusion of individual implementation factors between programs that were free (N = 22) versus fee-based (N = 15) (Table 3). For programs that had no research evidence (N = 28) versus programs with research evidence (N = 9), four implementation factors had significantly higher odds of being included in research-based programs. These included *policy incorporation* (incorporating the program into policy, or reference school/district policy), *school readiness* (scaling/tailoring the program based on the school's level of readiness), *teacher attitude/value of PA* (improving teacher attitudes/values about their own PA), and *implementation leaders* (identifying/appointing

Table 3 | Differences in inclusion of implementation factors across key Intervention Characteristics

Odds Ratios (0 is the reference category for each group)

	Free (0) vs. Cost (1) Free: N = 22; Cost: N = 15			No Research Evidence (0) vs. Research Evidence (1) No research: N = 28; Research: N = 9			Targeted to teacher only (0) vs. targeted to school (1) Teacher: N = 17; School: N = 20		
	%(0)	%(1)	OR (CI) or χ²	%(0)	%(1)	OR (CI) or χ²	%(0)	%(1)	OR (CI) or χ²
Inner Setting									
Communication[a]	27.3	6.7	0.19 (0.02, 1.78)	17.9	22.2	1.31 (0.21, 8.32)	11.8	25.0	2.50 (0.42, 14.96)
Policy Incorporation[a]	22.6	26.7	1.24 (0.27, 5.64)	14.3	55.6	7.50 (1.39, 40.56)*	17.6	30.0	2.00 (0.42, 9.63)
Marketing Materials Teachers[a]	36.4	40.0	1.17 (0.30, 4.50)	32.1	55.6	2.64 (0.59, 12.25)	23.5	50.0	3.25 (0.78, 13.48)
Marketing Materials Students/Parents[b]	27.3	26.7	0.97 (0.22, 4.26)	25.0	33.3	1.50 (0.29, 7.65)	11.8	40.0	5.00 (0.89, 28.08)
Gauging/Affecting Climate[a]	22.7	6.7	0.24 (0.03, 2.33)	14.3	22.2	1.71 (0.29, 11.40)	5.9	25.0	5.33 (0.56, 51.09)
Leadership Initial Buy In[a]	27.3	20.0	0.67 (0.14, 3.22)	17.9	44.4	3.68 (0.72, 18.82)	5.9	40.0	10.67 (1.17, 97.19)*
Student Management[b]	40.9	40.0	0.96 (0.25, 3.67)	35.7	55.6	2.25 (0.49, 10.34)	41.2	40.0	0.95 (0.26, 3.55)
Compatibility Adaptations[b]	68.2	40.0	0.31 (0.08, 1.22)	53.6	66.7	1.73 (0.36, 8.35)	52.9	60.0	1.33 (0.36, 4.93)
Incentives[a]	22.7	13.3	0.52 (0.09, 3.14)	14.3	33.3	3.00 (0.53, 17.16)	11.8	25.0	2.50 (0.42, 14.96)
Goal Setting[a]	9.1	6.7	0.71 (0.06, 8.67)	7.1	11.1	1.63 (0.13, 20.36)	0.0	15.0	2.78[c]
Monitoring[a]	27.3	33.3	1.33 (0.32, 5.55)	21.4	55.6	4.58 (0.93, 22.59)	5.9	50.0	16.00 (1.77, 144.72)*
School Readiness[c]	4.5	6.7	1.50 (0.09, 26.01)	0.0	22.2	6.58[c]*	0.0	10.0	1.80[c]
Leadership Engagement Post Adoption[a]	22.7	6.7	0.24 (0.03, 2.33)	14.3	22.2	1.71 (0.29, 11.40)	5.9	25.0	5.33 (0.56, 51.09)
Classroom Structure[b]	40.9	33.3	0.72 (0.18, 2.84)	28.6	66.7	5.00 (0.99, 25.02)	29.4	45.0	1.96 (0.50, 7.69)
Characteristics of Individuals									
Health Benefits[a]	77.3	73.3	0.81 (0.18, 3.69)	67.90	100.0	3.82[c]	64.7	85.0	3.09 (0.64, 15.00)
Non-Health Benefits[a]	72.7	93.3	5.25 (0.56, 49.08)	78.6	88.9	2.18 (0.23, 21.04)	70.6	90.0	3.75 (0.62, 22.58)
Teacher Motivation/Attitudes Around Program[a]	13.6	13.3	0.97 (0.14, 6.69)	10.7	22.2	2.38 (0.33, 17.17)	11.8	15.0	1.32 (0.19, 9.02)
Self-efficacy[a]	9.1	20.0	2.50 (0.36, 17.17)	10.7	22.2	2.38 (0.33, 17.17)	23.5	5.0	0.17 (0.02, 1.71)
Teacher Stage of Change[a]	4.5	6.7	1.50 (0.09, 26.01)	7.1	0.0	0.68[c]	11.8	0.0	2.49[c]
Teacher Attitude/Value toward PA[a]	13.6	20.0	1.58 (0.27, 9.17)	7.1	44.4	10.4 (1.48, 72.99)*	11.8	20.0	1.88 (0.30, 11.78)
Process									
Scheduling Materials[b]	40.9	53.3	1.65 (0.44, 6.20)	39.3	66.7	3.09 (0.64, 15.00)	17.6	70.0	10.89 (2.26, 52.42)*
Dose/Dose Quantity[b]	77.3	80.0	1.18 (0.24, 5.89)	75.0	88.9	2.67 (0.28, 25.25)	70.6	85.0	2.36 (0.47, 11.82)

Table 3 | Continued

	Odds Ratios (0 is the reference category for each group)								
	Free (0) vs. Cost (1)			No Research Evidence (0) vs. Research Evidence (1)			Targeted to teacher only (0) vs. targeted to school (1)		
	Free: $N = 22$; Cost: $N = 15$			No research: $N = 28$; Research: $N = 9$			Teacher: $N = 17$; School: $N = 20$		
	%(0)	%(1)	OR (CI) or χ^2	%(0)	%(1)	OR (CI) or χ^2	%(0)	%(1)	OR (CI) or χ^2
Teacher Participation[b]	31.8	53.3	2.45 (0.63, 9.49)	39.3	44.4	1.24 (0.27, 5.64)	35.3	45.0	1.50 (0.38, 5.66)
Implementation Leaders[a]	18.2	20.0	1.13 (0.21, 5.95)	7.1	55.6	16.25 (2.32, 114.06)*	5.9	30.0	6.86 (0.73, 64.10)
External Involvement[a]	27.3	33.3	1.33 (0.32, 5.55)	28.6	33.3	1.25 (0.25, 6.26)	17.6	40.0	3.11 (0.67, 14.44)
External Information Sharing[a]	45.5	26.7	0.44 (0.12, 1.80)	39.3	33.3	0.77 (0.16, 3.75)	29.4	45.0	1.96 (0.50, 7.69)
Accountability[a]	0.0	6.7	1.51c	0.0	11.1	3.20c	0.0	5.0	0.87c
Outcomes[a]	13.6	40.0	4.22 (0.86, 20.85)	17.9	44.4	2.68 (0.72, 18.82)	5.9	40.0	10.67 (1.17, 97.19)*

[a] Construct affects school–teacher relationship for implementation.
[b] Construct affects teacher–student relationship for implementation.
c OR not calculable, χ^2 value provided.
*Indicates significant difference, $p < .05$.
CFIR Consolidated Framework for Implementation Research; CBPA classroom-based physical activity.

champions or creating new leadership roles for implementation). Among programs targeted to the teacher only (N = 17) versus those targeted to the school (N = 20), four implementation factors had significantly higher odds of being included in programs targeting the school-level audience. These included *leadership initial buy-in* (increasing administrator buy-in for program adoption), *monitoring* (monitoring teacher implementation of classroom PA), *scheduling materials* (scheduling classroom PA), and *outcomes* (assessing desired outcomes).

T-test comparisons of index scores, representing the total number of factors included within each CFIR Domain and each of the school/teacher groupings, revealed that there were no differences between programs that were free versus those that were fee-based (Table 4). Programs that had research evidence had significantly higher index scores (i.e., were more likely to include constructs within the domain) for the Inner Setting (t = −2.97, p < .05), Process (t = −1.82, p < .05), and school−teacher relationship (t = −3.02, p < .05) than programs that did not have published research evidence. Programs that targeted the school had significantly higher index scores for the Inner Setting (t = −3.37, p < .05), Process (t = −3.24, p < .05), school−teacher relationship (t = −3.13, p < .05), and teacher−school relationship (t = −2.06, p < .05) versus those that targeted the teacher.

Examples of program content that received a score of two on the initial 0−2 coding scale, representing 6.7 per cent of all scores, are presented in Appendix C.

DISCUSSION

This research identified a large number of packaged, adoption-ready programs for supporting CBPA in schools. Programs ranged in their adaptability, intended audience, and PA delivery mode (e.g., teacher-delivered vs. online video modules), providing end users with a plethora of options. However, no programs extensively addressed/included theory-based contextual factors related to supporting implementation, such as improving school climate, facilitating teacher-level behavior change techniques, and evaluating program maintenance. Although some programs offered detailed support manuals, they were most often related to skill-building for activity delivery or promoting school-level program adoption. It is likely that more extensive implementation supports, particularly those that address ways to overcome the many organizational- and individual-level barriers to ongoing implementation of CBPA, are needed to improve the real-world effectiveness of such programs.

Within the Intervention Characteristics domain of CFIR, which generally represented the packaging of and options within the program, features varied largely across programs. This is potentially

Table 4 | Differences in index scores across key Intervention Characteristics

Groupings	Free (0) vs. Cost (1)			No Research Evidence (0) vs. Research Evidence (1)			Targeted to teacher only (0) vs. targeted to school (1)		
	(0) %(SD)	(1) %(SD)	T-statistic	(0) %(SD)	(1) %(SD)	T-statistic	(0) %(SD)	(1) %(SD)	T-statistic
CFIR Domains									
Inner Setting	28.57 (18.18)	21.90 (19.37)	1.05	21.17 (17.44)	40.48 (15.15)	−2.97*	15.97 (15.47)	34.29 (17.28)	−3.37*
Characteristics of Individuals	31.82 (17.75)	37.78 (18.33)	−0.99	30.36 (17.60)	46.30 (13.89)	−2.47*	32.35 (21.63)	35.83 (14.58)	−0.58
Process	31.82 (22.07)	39.17 (27.49)	−0.90	30.80 (22.17)	47.22 (27.80)	−1.82	22.79 (13.43)	45.00 (27.02)	−3.24*
School/Teacher Grouping									
School–Teacher Relationship	24.68 (15.10)	24.76 (19.81)	−0.02	20.41 (14.48)	38.10 (17.66)	−3.02*	16.25 (12.15)	31.90 (17.28)	−3.13*
Teacher–Student Relationship	46.75 (27.94)	46.67 (28.29)	0.01	42.35 (29.22)	60.32 (17.17)	−1.74	36.97 (24.77)	55.00 (27.92)	−2.06*

*Indicates significant difference, p < .05.

beneficial for teachers, since many value the ability to tailor programs to meet the specific needs of their classroom [20, 22]. A majority of programs included structured PA that was flexible in duration, which also provides flexibility to teachers. Most programs did not include formal training to implement CBPA and more often included an educational handout or resource guide/booklet. Although the provision of booklet/handout-type resources has value for ongoing implementation support, structured training in the form of professional development or preservice learning—provided in conjunction with ongoing coaching—is likely to be a more effective approach for supporting ongoing implementation when compared with receiving materials alone [33]. Thus, many of the adoption-ready programs identified in this review may be more appropriate for stakeholders who have been introduced to CBPA previously, rather than first-time adopters.

The most commonly included implementation factors within the Inner Setting, Characteristics of Individuals, and Process domains of CFIR, were related to highlighting the physical and mental benefits of CBPA, and supporting adaptations to the delivery of CBPA. The consensus across programs, with regard to increasing teachers' knowledge of the benefits of CBPA, suggests that this is an essential core component of CBPA programs. However, research shows that knowledge is typically not sufficient for supporting sustainable behavior change [34]. Adaptability is critical for successful implementation, as contextual factors can vary widely across settings and "one size fits all" programs are generally not well received or sustainable [35, 36]. Although many programs are being adapted in local contexts [7], guidance on adaptations can be beneficial for maintaining fidelity to the most critical aspects of the program while permitting flexibility to other aspects.

The lack of significant differences in implementation factor inclusion between free and fee-based programs suggests that both have similar potential for supporting successful implementation. Although intervention cost is often a consideration in program adoption [37], school- or district-level leaders should consider whether programs have been empirically tested before making decisions regarding program uptake [38]. Indeed, programs with published research evidence had higher inclusion of implementation factors with organizational-level implications (e.g., incorporating policy and assessing school readiness) than programs without an evidence base. Thus, programs created in research settings should be highlighted when disseminating CBPA programs and resources.

An individual teacher-directed approach was common among programs, illustrated by the higher index scores among the student−teacher relationship implementation factors versus the school−teacher relationship implementation factors. This corroborates previous evidence showing that many school-based PA programs have focused on developing teachers' skills and knowledge, with less attention paid to behavior change, organizational factors, and other implementation drivers [39]. With so many programs addressing teacher-level factors, it seems that many programs put the responsibility for student behavior change solely in the hands of teachers, which is not supported by recent literature on effective implementation of PA programs [26]. In accordance with systems approaches, multiple stakeholders within a school, not just teachers, play a critical role in the success of CBPA program implementation. Successful implementation efforts are likely to be those that create school-level changes, including changes in norms and culture around PA during the school day, through key features such as administrative buy-in/support, goal setting, and monitoring of progress. Among programs reviewed here, few included these implementation factors, with 24.3, 8.1, and 29.7 per cent including gaining initial administrative buy-in, setting goals for teacher implementation of CBPA, and monitoring progress, respectively. Interestingly, even programs that were targeted to the school (vs. to teacher only) more adequately included implementation factors related to both the school−teacher relationship *and* the teacher−student relationship, further highlighting the necessity of the whole-of-school approach for increased implementation support.

Regarding teacher factors, although monitoring was included in over a third of programs with implementation materials, it was evident that goal setting, teacher stage of change, teacher attitudes, and other teacher-level behavior change techniques were rarely included. Since goal setting and monitoring in particular have been among the most consistently effective tools in behavior change interventions [40, 41], future CBPA efforts should aim to better incorporate and test these tools. Regarding school-level implementation factors, over one-third of programs included external involvement and information sharing, but leadership engagement and school climate were seldom included. Previous research shows that leadership characteristics (specific to CBPA) and school climate around CBPA are important predictors of implementation [20, 21, 23, 24, 42]. Future CBPA research should aim to develop (or utilize previously developed) theoretically based tools that both support school stakeholders' ability to implement the program and address the contextual factors that serve as barriers or facilitators to implementation. Improving attitudes toward implementation of CBPA would also likely benefit climate around PA in general and could further aid in implementation of a Comprehensive School Physical Activity Program [3, 4].

In general, CBPA programs are readily available, but likely do not provide enough supporting materials alone to enable broad adoption and implementation across schools. CBPA programs should prioritize the inclusion of these materials to maximize usability. Resources that have been developed and curated by the Centers for Disease Control and Prevention to support school-wide implementation of health interventions [43] and particularly CBPA implementation [44] can provide guidance in this area. Importantly, Leeman and colleagues noted that the complexity of tools was a barrier for school-level uptake; thus, there is a give and take between the complexity of a resource and its utility for facilitating school-wide change [43]. Stakeholders who are disseminating programmatic resources for schools should consider this balance between resource complexity (including the number of implementation factors addressed) and pragmatic usability to ensure that the resource will best fit the needs of a particular school context.

Strengths and limitations

This study was among the first to systematically investigate adoption-ready CBPA programs for their inclusion of theory-based implementation contextual factors. Our coding process yielded acceptable inter-rater agreement, which supports the validity of the data. However, some content could have been missed, which could have led to measurement error, but we made efforts to communicate with program contacts to obtain materials exclusively available by request and allow them to point out potential inaccuracies in our coding. The list of implementation factors was created using the investigators' knowledge of the literature and experience in CBPA research, but the list may not contain all factors that are important for implementation. Future studies should use other methods to identify and rank the importance of various implementation factors and strategies for supporting CBPA implementation, such as concept mapping or the Delphi method [45, 46].

CONCLUSIONS

Although many CBPA programs and resources exist, more work is needed to overcome the numerous barriers to widespread and ongoing implementation of CBPA, as simply training teachers to deliver CBPA is often not sufficient. Existing programs should be supplemented with efforts to deliver implementation strategies that address the unique contextual factors faced by each school. These efforts likely need to address systems' changes at the organizational and individual levels and should be prioritized in future research. This work can benefit from the use of implementation science frameworks and methods, which is becoming more common in community-based research.

SUPPLEMENTARY MATERIAL

Supplementary material is available at *Translational Behavioral Medicine* online.

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